CHARACTERIZATION AND ANTIBACTERIAL ACTIVITY OF HEXADECYLTRIMETHYLAMMONIUM MODIFIED SILVER KAOLINITE

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Specially dedicated to:

My inspring grandparents;

My grandfather, M. Komarasami

My grandmother, R. Thanapakiam

My loving parents;

My father, K. Muthoovaloo

My mother, J. Susila

My beloved fiancée;

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ABSTRACT

The current study focused on the preparation, characterization and evaluation for antibacterial activity of hexadecyltrimethylammonium modified silver kaolinite (DUAL-ANTIBAX®). DUAL-ANTIBAX® was prepared by adding Ag-Kaolinite with surfactant, hexadecyltrimethylammonium (HDTMA). The prepared samples; Kao (raw kaolinite), Ag-Kao, HDTMA-Kao and DUAL- ANTIBAX® were characterized using an X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, field emission scanning-electron microscopy (FESEM), energy dispersive X-ray (EDX) analyser, zeta potential analysis and dispersion behaviour. The samples were observed to have no structural changes and HDTMA and Ag were successfully loaded on kaolinite. DUAL-ANTIBAX® has a positive value of zeta potential due to the presence of surfactants. The antibacterial activity of these samples was determined by Minimum Inhibition Concentration (MIC) assay against *Staphylococcus aureus* and *Escherichia coli* in different saline solution concentrations (0%, 0.01%, 0.1%, 1.0% and 5.0%) and at different time of incubation (30 minutes and 24 hours). As a result, DUAL-ANTIBAX® showed better antibacterial activity at lower concentration of saline solution. Meanwhile, DUAL-ANTIBAX® exhibited better antibacterial activity at time of incubation of 24 hours compared to 30 minutes. This study also revealed that, DUAL-ANTIBAX® was more effective on the Gram positive bacteria compared to the Gram negative bacteria. As a conclusion, DUAL-ANTIBAX® can be used as an effective antibacterial agent due to the combination of Ag and HDTMA on kaolinite as a carrier system. Results from this study has highlighted the potential use of DUAL-ANTIBAX® as antibacterial agent and may have an implications to the development of new antibacterial agent.

ABSTRAK

Kajian ini bertujuan untuk menyediakan, mencirikan dan menilai aktiviti antibakteria heksadesiltrimetil ammonium diubahsuai dengan perak kaolinit (DUAL-ANTIBAX®). DUAL-ANTIBAX® telah disediakan dengan mengubahsuai ion perak dan surfaktan, heksadesiltrimetil ammonium (HDTMA) pada kaolinit. Kajian pencirian telah dijalankan terhadap sampel kaolinit (Kao), perak-kaolinit (Ag-Kao), surfaktan-kaolinit (HDTMA-Kao) dan DUAL-ANTIBAX® dengan menggunakan kaedah pembelauan sinar-X (XRD), spektroskopi inframerah (FTIR), mikroskopi imbasan electron (FESEM), penganalisis tenaga serakan sinar-X (EDX), analisis potensi zeta dan sifat-sifat penyebaran. Kesemua sampel didapati tidak mengalami sebarang perubahan struktur. Manakala HDTMA dan Ag didapati telah berjaya dimuatkan pada kaolinit. Disebabkan kehadiran surfaktan, DUAL-ANTIBAX® mempunyai nilai positif bagi analisa zeta potensi. Kemudian, aktiviti antibakteria telah ditentukan dengan menggunakan kaedah asai kepekatan perencatan minimum (MIC) terhadap *Staphylococcus aureus* dan *Escherichia coli* dalam kepekatan larutan garam yang berbeza (0%, 0.01%, 0.1%, 1.0% dan 5.0%) dan tempoh masa inkubasi yang berbeza (30 minit dan 24 jam). Berdasarkan nilai MIC, DUAL-ANTIBAX® menunjukkan aktiviti antibakteria yang lebih baik pada kepekatan garam yang rendah. DUAL-ANTIBAX® juga mempunyai aktiviti antibakteria yang lebih baik pada masa inkubasi 24 jam berbanding dengan 30 minit. Di samping itu, DUAL-ANTIBAX® didapati lebih berkesan terhadap bakteria Gram positif berbanding bakteria Gram negatif. Kesimpulannya, DUAL-ANTIBAX® boleh digunakan sebagai agen anti-bakteria yang berkesan disebabkan gabungan Ag dan HDTMA pada kaolinit sebagai sistem pembawa. Keputusan kajian ini telah menekankan potensi penggunaan DUAL-ANTIBAX® sebagai agen antibakteria dan mungkin mempunyai implikasi kepada pembangunan agen antibakteria baru.